Record and Retrieval Thread

Atlas DP1

Checkout and Launch Control System (CLCS)

84K00303-012

Approval:

_____

Chief, System Engineering and Integration Division Date

NOTE: See "**Supporting Document Note**" on following page

PREPARED BY: Earl Johnson

Supporting Document Note: Acronyms and definitions of many common CLCS terms may be found in the following documents: CLCS Acronyms 84K00240 and CLCS Project Glossary 84K00250.

REVISION HISTORY

REV	DESCRIPTION	DATE

LIST OF EFFECTIVE PAGES				
Dates of issue of change pages are:				
Page No.	**A or D***	**Issue or Change No.**	**CR No.**	**Effective Date****

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1.

Assessment Team

Name	CI Represented	E-Mail Address	Phone
Earl Johnson	SDC SE&I	earl.johnson-1	861-7690
Justin Beaver	Common Gateway Services	justin.beaver-1	861-7683
Tom Beever	Advisory Tools, Data Support Tools	x400	861-7367
Ray Bessenaire	System Services, System Msgs	besserg@ kscgws.ksc.nasa.gov	861-9045
Ken Castner	Redundancy Mgmt	castna@kscgws.ksc.nasa.gov	861-9020
Coleman Dugger	Advisory Tools, Data Support Tools	curtis.dugger-1	861-2241
Gary Hrezo	System Viewers	gary.hrezo-1	861-9002
Tom Jamieson	SE&I Packet Payload Format	tom.jamieson	861-9088
Charla King	Test Build	charla.king-1	861-7587
Roger Lee	SDS Services	roger.lee-1	861-7697
Kurt Leucht	DRP Services	kurt.leucht-1	861-7594
Bob McMahon	System Services, System Msgs	x400	861-9045
Steve Moore	OpsCM, ORT	steve.moore-1	861-7394
Shawn Quinn	Gateways	shawn.quinn-1	861-7392
Jack Raucci	Data Dist, Health, Fusion, Cnstr. Mgmt	jack.raucci	861-9021

1. INTRO

1.1 RECORD AND RETRIEVAL OVERVIEW

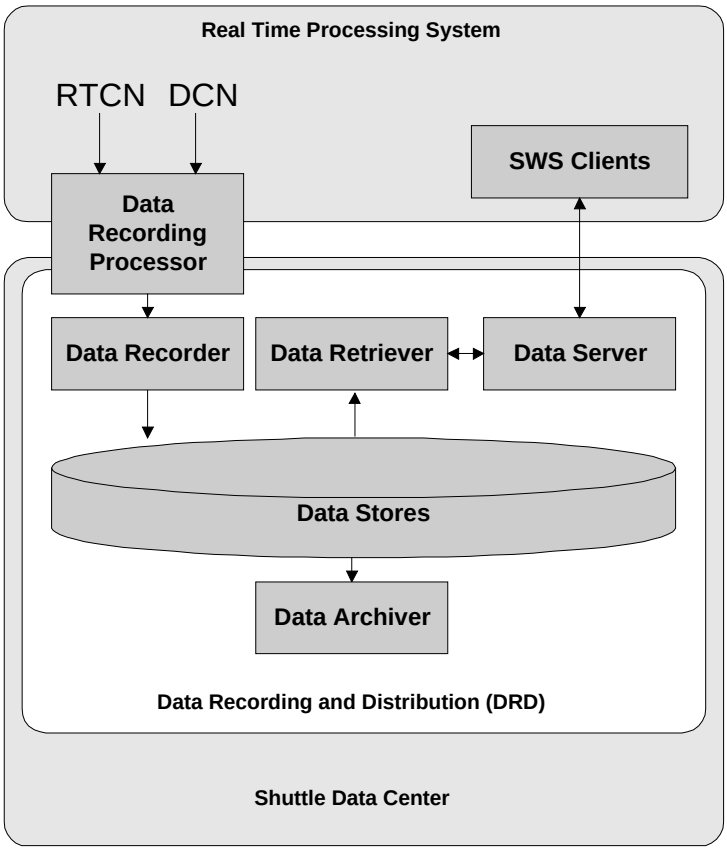
This thread establishes the frame work for CLCS data recording/retrieval, and begins the migration of the retrieval process from the CCMS PDR/SPA and CDS/Shuttle Data Center to the CLCS system.

This thread assessment does not include CCWS and SWS presentation of the retrieved data (e.g. viewers, application displays).

1.2 RECORD AND RETRIEVAL CONCEPT

The Record and Retrieve Services Phase 2 Thread provides the capability to record RTPS FD change data, system messages, Computer-To-Computer (C-T-C) data, and block log data. Retrieval services are also provided for these data types. This is accomplished through the Data Recording and Distribution (DRD) subsystem of the Shuttle Data Center (SDC).

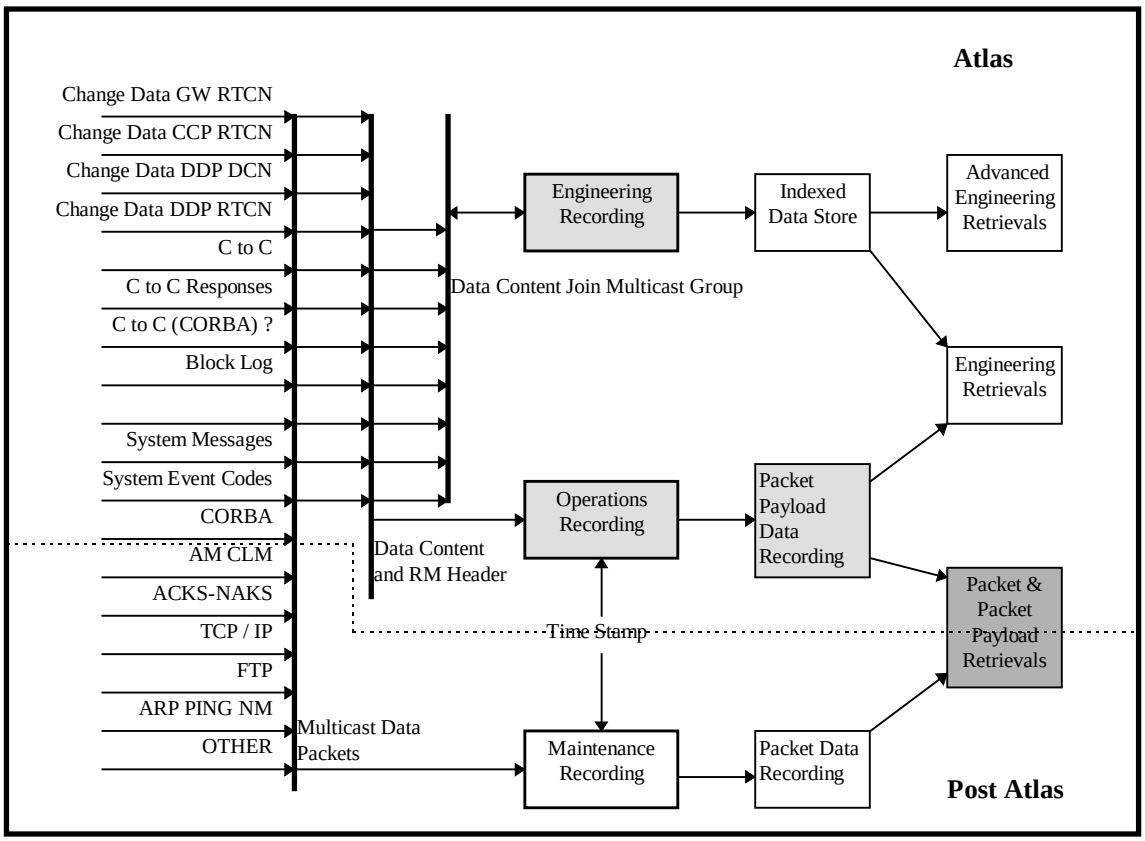
The Data Recording Processor (DRP) receives all RTPS data. It is a front-end for SDC recording acting as a concentrator, merging, sequencing, and re-packetizing RTPS data, which it then sends to SDC for recording. It also has limited data filtering capabilities. The DRP is the means by which RTPS recording is controlled. The following functional diagram depicts the relationship between the SDC DRD subsystem, the RTPS, and applications using the DRD as a data source for retrievals.



Three types of data recording have been defined for CLCS;

- Engineering Data Recording. This refers to 'Retrieval Optimized Recording' accomplished in the SDC. This data includes FD change Data from the DDP-to-CCP stream, and user/application initiated commands. Satisfied by SDC recording.
- Operations Data Recording. This refers to all RTPS data that uses Reliable Messaging (RM) and follows the RTPS Packet Payload ICD. Satisfied by SDC recording.
- Network Operations and Maintenance Data Recording. This refers to all data on the RTPS. As this data is typically used for troubleshooting network problems, its added value is the physical and Data Link network level protocols (layer 1 and 2). Satisfied by TBD.

Note there are some differences between these definitions an those in the in the Con Ops (See section 5).



Legend

Complete Atlas Partial Atlas

Each of these recording categories have specific characteristic and uses, as shown in the table below. Engineering Data is typically pertinent to the test article or end item, and is represented by function designator measurements and commands as well as other data originated by end users and application programs. Also, certain TCID information is properly Engineering Data. While the integrity of this data is as important if not more so as that of the O&M centered data, it's use dictates alternate recording and retrieval requirements.

Initial efforts concentrated on recording and retrieval of network packet data, as this data is most useful in development, system debug and troubleshooting activities. This is supported by the packet recording capabilities provided in Thor. This data has proved to be difficult to retrieve however. At this time, not all providers of system data utilize Reliable Messaging (RM). The use of multiple packet header formats (other than RM) introduce interpretation ambiguities which may result in erroneous retrieval of data. This is a temporary problem and is manifest only when retrieving packet data. Once the essential CLCS RTPS data sources on the RTCN and DCN use RM, this will cease to be a problem.

There have been many issues surrounding the recording, retrieval and retention of CLCS data. They have ranged from terminology problems and conflicting requirements to the availability of hardware and representative RTPS data traffic samples. Most of these issues have been worked through and addressed. There remains the issue Network O&M data recording. In the interim, a combination of SDC recording and network analyzers will suffice for this purpose.

The focus of recording and retrieval efforts for this delivery is to be that of Operations Data recording and retrieval.

The following table shows the predominant characteristics of each category of data recording, the origin of the data, it's use and purpose.

Engineering Data	**Operations Data**	**Network Operations & Maintenance**
Purpose/Activity Supported		
End Item Centered	CLCS System Centered	Network Centered
End Item Troubleshooting	CLCS System Level Troubleshooting	Network Level Troubleshooting
Application Program Development	CLCS System Development	Performance Tuning
Engineer/Application View	CLCS System Services View	Network Statistics
		System Monitoring
Data Characteristics		
Protocol Independent	CLCS Protocols Level	7 Layer Protocol Analysis
Data Content	Data Content and Delivery	Data Delivery/Communications
Detail Governed By End Item(s)	Great Detail	Greatest Detail
Variable Time Horizons	Variable Time Horizons	Short Time Horizons
End Item Event Oriented		TCP, IP, 802, All Network Traffic
Data Origination		
End Item(s)	End Item(s)	End Item(s)
User Initiated	User Initiated	User Initiated
	System Operations/Protocols	System Operations/Protocols
		Network Operations/Protocols
Data Capture/Record		
SDC	SDC & Network Analyzers	TBD

The table below depicts RTPS data types, the planned retrieval filters available for them, and the manner of presentation and display of this data. In the table, 'Viewers' implies an RTPS viewer on a CCWS, and 'Display Tools' implies a Data Support Tool product on the SWS.

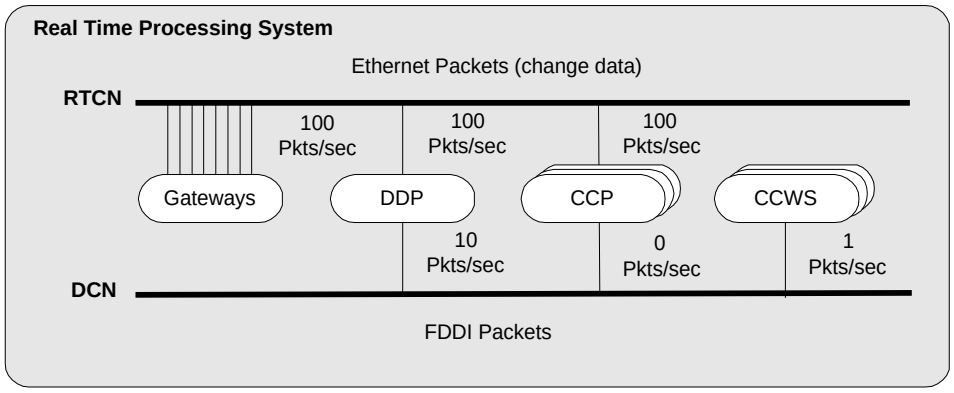
Data Category/Type	Collect	Record	Retrieve Filters	Convert	Viewers*	Display Tools
Data Source Format	DRP	SDC	SDC	SDC	CCWS	SWS
Computer-to-Computer						
- Commands	RM	PP ICD	FD,Src,Dst,Tm,Typ	Bin, BA		X
- Command Response	RM	PP ICD	FD,Src,Dst,Tm,Typ	Bin, BA		X
- CORBA		PP ICD	Src,Dst,Tm			
- Fusion Param. Changes	RM	PP ICD	FD,Src,Dst,Tm			
- Cnstr. Mgmt Violations	RM	PP ICD	FD,Src,Dst,CID,Tm		X	
- System Messages	RM	PP ICD	Src,MID,Tm	Bin,Asc,IN	X	
Block Log Data						
- Block Log Data (general)	RM	PP ICD	LID,Tm	Bin		X
- Inter-Process-Comm	RM	PP ICD	LID,Tm	Bin		X
- Inter-Subsystem-Msgs.	RM	PP ICD	LID,Tm	Bin		X
- Maintenance Monitor						
- Resource Utilization						
- RT Diagnostics Msgs.						
- Performance Monitor						
FD Change Data						
- FD Change Data streams	RM	PP ICD	FD,Src,Tm,Typ		X	X
- Data Fusion	RM	PP ICD	FD,Src,Tm,Typ		X	X
- Pseudo Changes	RM	PP ICD	FD,Src,Tm,Typ		X	X
- Health & Status	RM	PP ICD	FD,Src,Tm,Typ			X
System Event Code						
- System Config. Table	RM	PP ICD		Bin		
- System Integrity	RM	PP ICD		Bin		

Notes: * Viewers operate with real time data only---acquired from the network, rather than an SDC retrieval.
An 'X' in the viewer or display tool column implies a presentation capability exists for Atlas.

Legend

Filter Name	Designation	Data Type	Designation
Select by FD	FD	ASCII	Asc
Select by Source	Src	Binary Data	Bin
Select by Destination	Dst	Mixed Binary/ASCII	BA
Select by Time	Tm	Inserts Replaced	IN
Select by Type	Typ	**Protocol Format**	
Constraint ID	CID	Reliable Messages	RM
Log ID	LID	Payload Packet ICD	PP ICD
Message ID	MID		

Nominal change data traffic packet load contributed by each RTPS system.



The following tables quantify RTPS network data rates. Four network activity states are shown; peak activity, nominal activity, launch activity, and quiescent (no activity). While these data rates are high, they are within planned the RTPS/SDC recording capabilities.

For purposes of calculating system load (below), an additional factor of .5 is included to cover Block Logging, commands, and message traffic. This is consistent with observed CCMS data.

		Peak Data Rate						
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
Quantity	8	8	1	1	8	8	50	
Packet/Second RTCN	100	100	100	100	100	100	0	
Number of FDs/Packet	63	1	610	1	10	1	0	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	500	8	4,877	8	80	8	0	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	532	40	4,909	40	112	40	32	
Max IP Packet Size	1,472	1,472	1,472	1,472	1,472	1,472	1,472	
Number of TCP Packets	1	1	4	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	532	40	493	40	112	40	32	**TOTAL**
Bytes/Second RTCN	**459,200**	**65,600**	**507,680**	**8,200**	**123,200**	**65,600**	**0**	**1,229,480**
Packet/Second DCN	0	0	10	10	0	0	1	
Number of FDs/Packet	0	0	6,096	0	0	0	3	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	0	0	48,768	0	0	0	24	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	32	32	48,800	32	32	32	56	
Max IP Packet Size	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Number of TCP Packets	1	1	13	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	32	32	800	32	32	32	56	**TOTAL**
Bytes/Second DCN	**0**	**0**	**493,460**	**740**	**0**	**0**	**4,900**	**499,100**

		Quiescent						
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
Quantity	8	8	1	1	8	8	50	
Packet/Second RTCN	100	100	100	100	100	100	0	
Number of FDs/Packet	1	1	19	1	1	1	0	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	8	8	154	8	8	8	0	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	40	40	186	40	40	40	32	
Max IP Packet Size	1,472	1,472	1,472	1,472	1,472	1,472	1,472	
Number of TCP Packets	1	1	1	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	40	40	186	40	40	40	32	**TOTAL**
Bytes/Second RTCN	**65,600**	**65,600**	**22,760**	**8,200**	**65,600**	**65,600**	**0**	**293,360**
Packet/Second DCN	0	0	10	10	0	0	1	
Number of FDs/Packet	0	0	192	0	0	0	3	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	0	0	1,536	0	0	0	24	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	32	32	1,568	32	32	32	56	
Max IP Packet Size	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Number of TCP Packets	1	1	1	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	32	32	1,568	32	32	32	56	**TOTAL**
Bytes/Second DCN	**0**	**0**	**16,100**	**740**	**0**	**0**	**4,900**	**21,740**

			Nominal					
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
Quantity	8	8	1	1	8	8	50	
Packet/Second RTCN	100	100	100	100	100	100	0	
Number of FDs/Packet	5	1	58	1	10	1	0	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	40	8	461	8	80	8	0	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	72	40	493	40	112	40	32	
Max IP Packet Size	1,472	1,472	1,472	1,472	1,472	1,472	1,472	
Number of TCP Packets	1	1	1	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	72	40	493	40	112	40	32	**TOTAL**
Bytes/Second RTCN	**91,200**	**65,600**	**53,480**	**8,200**	**123,200**	**65,600**	**0**	**407,280**
Packet/Second DCN	0	0	10	10	0	0	1	
Number of FDs/Packet	0	0	576	0	0	0	3	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	0	0	4,608	0	0	0	24	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	32	32	4,640	32	32	32	56	
Max IP Packet Size	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Number of TCP Packets	1	1	2	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	32	32	640	32	32	32	56	**TOTAL**
Bytes/Second DCN	**0**	**0**	**47,240**	**740**	**0**	**0**	**4,900**	**52,880**

		Launch Activity						
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
Quantity	8	8	1	1	8	8	50	
Packet/Second RTCN	100	100	100	100	100	100	0	
Number of FDs/Packet	15	1	154	1	10	1	0	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	120	8	1,229	8	80	8	0	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	152	40	1,261	40	112	40	32	
Max IP Packet Size	1,472	1,472	1,472	1,472	1,472	1,472	1,472	
Number of TCP Packets	1	1	1	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	152	40	1,261	40	112	40	32	**TOTAL**
Bytes/Second RTCN	**155,200**	**65,600**	**130,280**	**8,200**	**123,200**	**65,600**	**0**	**548,080**
Packet/Second DCN	0	0	10	10	0	0	1	
Number of FDs/Packet	0	0	1,536	0	0	0	3	
Bytes/ FD	8	8	8	8	8	8	8	
Data Bytes/Packet	0	0	12,288	0	0	0	24	
Payload Header Bytes	16	16	16	16	16	16	16	
RM Header Bytes	16	16	16	16	16	16	16	
otal CLCS Bytes/Packet	32	32	12,320	32	32	32	56	
Max IP Packet Size	4,000	4,000	4,000	4,000	4,000	4,000	4,000	
Number of TCP Packets	1	1	4	1	1	1	1	
Packet Overhead Bytes	42	42	42	42	42	42	42	
Last Packet Size Bytes	32	32	320	32	32	32	56	**TOTAL**
Bytes/Second DCN	**0**	**0**	**124,880**	**740**	**0**	**0**	**4,900**	**130,520**

CCMS Recording								
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
CCMS FDs/sec Normal			4,000					
Hours Normal			4,320					
Size Bytes			4					
Sub Total Mbytes			248,832					
Cmds Msgs BFL (50%)			124,416					
Total Mbytes			373,248					
CCMS FDs/sec Launch			12,000					
Hours Launch			12					
Size Bytes			4					
SubTotal Mbytes			2,074					
Cmds Msgs BFL (50%)			1,037					
Total Mbytes			3,110					**TOTAL**
Grand Total Mbytes			376,358					**376,358**

Two parameters below are changed from the chart above. The CLCS FDs/sec parameter and the size parameter. below reflects an expected 20% increase in FD traffic over the existing CCMS, due primarily to data fusion FDs.

CLCS Recording								
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
CLCS FDs/sec Normal			4,800					
Hours Normal			4,320					
Size Bytes			8					
SubTotal Mbytes			597,197					
Cmds Msgs BFL (50%)			298,598					
Total Mbytes			895,795					
CLCS FDs/sec Launch			14,400					
Hours Launch			12					
Size Bytes			8					
SubTotal Mbytes			4,977					
Cmds Msgs BFL (50%)			2,488					
Total Mbytes			7,465					**TOTAL**
Grand Total Mbytes			903,260					**903,260**

CLCS Recording Packets								
Parameter	Gateways	Gateway Backups	DDP	DDP Backup	CCP	CCP Backups	CCWS	
CLCS FDs/sec Normal	11,400	8,200	12,590	1,118	15,400	8,200	613	
Size Bytes	8	8	8	8	8	8	8	
FD Bytes/sec	91,200	65,600	100,720	8,940	123,200	65,600	4,900	
Headers Bytes/sec	25,600	25,600	3,840	3,520	25,600	25,600	1,600	
Hours Normal	2,160	2,160	2,160	2,160	2,160	2,160	2,160	
SubTotal Mbytes	908,237	709,171	813,059	96,889	1,157,069	709,171	50,544	
Cmds Msgs BFL (50%)	454,118	354,586	406,529	48,444	578,534	354,586	25,272	
Total Mbytes	1,362,355	1,063,757	1,219,588	145,333	1,735,603	1,063,757	75,816	
CLCS FDs Launch	19,400	8,200	31,895	1,118	15,400	8,200	613	
Size Bytes	8	8	8	8	8	8	8	
FD Bytes/sec	155,200	65,600	255,160	8,940	123,200	65,600	4,900	
Headers Bytes	25,600	25,600	4,480	3,520	25,600	25,600	1,600	
Hours Launch	12	12	12	12	12	12	12	
SubTotal Mbytes	7,811	3,940	11,216	538	6,428	3,940	281	
Cmds Msgs BFL (50%)	3,905	1,970	5,608	269	3,214	1,970	140	
Total Mbytes	11,716	5,910	16,825	807	9,642	5,910	421	**TOTAL**
Grand Total Mbytes	1,374,071	1,069,667	1,236,413	146,141	1,745,245	1,069,667	76,237	**6,717,440**

The value indicated above, 6.7 TB (terabytes) represents a worse case SDC storage capacity per mission

1.3

RECORD AND RETRIEVAL SPECIFICATION

1.3.1 Statement of Work

All references to data below are considered to be CLCS data and data types. To collect, record, and retrieve this data it must adhere to the Real Time Processing System (RTPS) Packet Payload Interface Control Document (ICD) and utilize Reliable Messaging (RM) services.

Complete all Thor Requirements as summarized below:

Provide initial capability to record and retrieve the following CLCS Data and Data Types:

- Function Designators (FD) with health, time, and reason code information.
- Commands.
- System Messages.
- *Complete Ethernet packets with message protocol.*
- Note: Filtering appropriate to the data type will be provided on retrieval. Examples are: Source, Destination, Type, Time, etc.

Provide the capability to collect and record these CLCS data and data types:

- Block Log Data.
- Inter-process communication between User Applications. [Packet Service only]

Note: IPC provides two types of service. 1) Local service. Data does not have to be in a CLCS packet format. Data is queued locally and is not sent to the network. 2) Packet Service – Data must contain a C-to-C packet header. Data is transmitted on the network so that the DRP can pick it up.

- Inter-subsystem messages between machines.
- Commands and Command Responses.
- Change Data
    - Function Designators (FD).
    - Fused FD data.
    - Fused FD parameter changes.
    - Pseudo FD changes.
- Constraint Data
    - Constraint Management violation events.
    - Constraint Manager Message traffic.
- Selected System and User Application data.
- System Configuration Table data.
- System Integrity communications.
- *Shuttle Mass Memory dump data. (collect and record if available)*
- *Configuration data. (collect and record if available)*
- *Maintenance Monitor function communications (collect and record if available)*
- *Resource utilization data. (collect and record if available)*

- *Real-time diagnostic messages. (collect and record if available)*
- *Performance monitor messages and alerts. (collect and record if available)*

Provide the capability to retrieve these CLCS data and data types:

Note: Filtering appropriate to the data type will be provided on retrieval. Examples are: Source, Destination, Type, Time, etc.

- Block Log Data.
- Inter-process communication between User Applications.
- Inter-subsystem messages between machines.
- Commands and Command Responses.
- Change Data
    - Function Designators (FD).
    - Fused FD data.
    - Fused FD parameter changes.
    - Pseudo FD changes.
- Constraint Data
    - Constraint Management violation events.
    - Constraint Manager Message traffic.
- Selected System and User Application data (Block Log).
- System Configuration Table data.
- System Integrity communications.
- *Shuttle Mass Memory dump data (Block Log).*
- *Configuration data.*
- *Maintenance Monitor function communications.*
- *Resource utilization data.*
- *Real-time diagnostic messages.*
- *Performance monitor messages and alerts.*
- Phase II CLCS Retrieved Data Presentation (RDP) from Data Support Tools Thread (reference only)
    - Develop additional retrievals (reference only)
        - Develop a retrieval that combines the Console Activity Trace retrieval and the Operator Communications Retrieval (reference)
        - Develop a retrieval to support LDB/*UPLK* command data reporting (reference)
    - Enhancements to existing retrievals (reference only)
        - Output in health column (reference)
        - FD's requested as a group (reference)
        - FD's selectable by type and source (reference)
        - Output to a data file (reference)
- Provide Hardware and Software interface (Data Recording Processor (DRP)) between RTPS and Shuttle Data Center (SDC) for recording of Multicast RTPS data.

- *Provide the capability to assign one or two interfaces to each RTPS test set to provide redundancy for data recording, as required.*
- Provide RTPS standard reliable messaging and system integrity functions for control and status of the interface.
- Provide a system health function that conveys SDC data stream recording status (this may be polled or cyclical output, such as a heartbeat mechanism).
- Provide the capability to report the status of SDC data stream recording as a part of subsystem health.
- Provide the capability to pass the packet, including RM header data, in the data stream for recording.
- Provide a filtering capability, based the log bit as defined in the Packet Payload ICD and applied only to Engineering Data (FD change data).
- Provide the capability to accommodate bursts in data volume.
- Provide the capability to transmit, with minimum delay, the recording output stream to the SDC, with error recovery.
- Provide the capability to temporarily store the data stream on disk, and in the event the communication path or the recording process in SDC is interrupted, forward the stored data stream to SDC-DRD when the communication path or recording process is restored.
- *Provide a merged, time-stamped recording data output stream containing all Multicast packets, in the order received.*
- *Provide a selectable packet filtering capability, based on CLCS packet type, log bit, or flow control/handshaking.*

- Provide the interface for RTPS Command and Control Workstations (CCWS) and Command and Control Processor (CCP) to request and receive Retrieved Data from Shuttle Data Center.
  - Provide the capability to assure the security and integrity of the DCN connection.
  - Provide the capability to connect two interfaces to the DCN to provide redundancy for retrievals.
  - Provide the capability to insure connections originate only on the RTPS side of the interface.
  - Provide the capability to pass only point-to-point traffic on this interface between RTPS and SDC.
  - Provide the capability to block all Multicast traffic to the SDC on this interface.

1.3.2 SLS Requirements

General

- The RTPS shall record user actions that result, or potentially result, in changes to the state of the system (e.g., initiation of a program, issuing commands, program prompts and their responses, control panel switch changes, program text information messages, etc.). [Partial]
- RTPS inter-process communication between User Applications shall be recorded to the Shuttle Data Center. [Partial]
- The RTPS shall record all inter-subsystem messages to the Shuttle Data Center [Partial]
- The RTPS shall time tag all data with 100 microsecond tags for recording purposes. [Complete]

Measurement and Command Processing

- The RTPS shall record all measurement changes along with the health and sample time to the Shuttle Data Center. [Complete]
- The RTPS shall record all commands and command responses to the Shuttle Data Center. [Complete]
- The RTPS shall record all Fused Data FD and Fused FD parameter changes to the Shuttle Data Center. [Complete]
- The RTPS shall record all Pseudo FD changes to the Shuttle Data Center. [Complete]
- The RTPS shall record all measurement health changes to the Shuttle Data Center. [Complete]
- The RTPS shall record all Constraint Management violation events to the Shuttle Data Center. [Partial]
- All messages sent to and received from the Constraint Manager shall be recorded to the Shuttle Data Center. [Partial]

Miscellaneous System Services

- The CLCS shall provide the capability for System and User Applications to record data to the Shuttle Data Center. [Complete]
- The RTPS shall record all System Messages to the Shuttle Data Center. [Complete]
- The RTPS shall provide the capability to record memory dump data to the Shuttle Data Center. [Partial]

System Control

- The RTPS shall record all configuration information to the Shuttle Data Center. [Partial]
- The RTPS shall record all communications to the Maintenance Monitor function to the Shuttle Data Center. [None]
- The RTPS shall record all System Integrity communications to the Shuttle Data Center. [Partial]
- The RTPS shall record resource utilization data for off-line analyses. [None]
- The RTPS shall record all real-time diagnostics messages to the Shuttle Data Center. [None]
- The RTPS shall record all performance monitor messages and alerts to the Shuttle Data Center. [None]

Retrieval Requirements

- The RTPS shall provide the capability for System and User Applications to retrieve near-real-time and archived data from the Shuttle Data Center. [Partial]

Other System Requirements

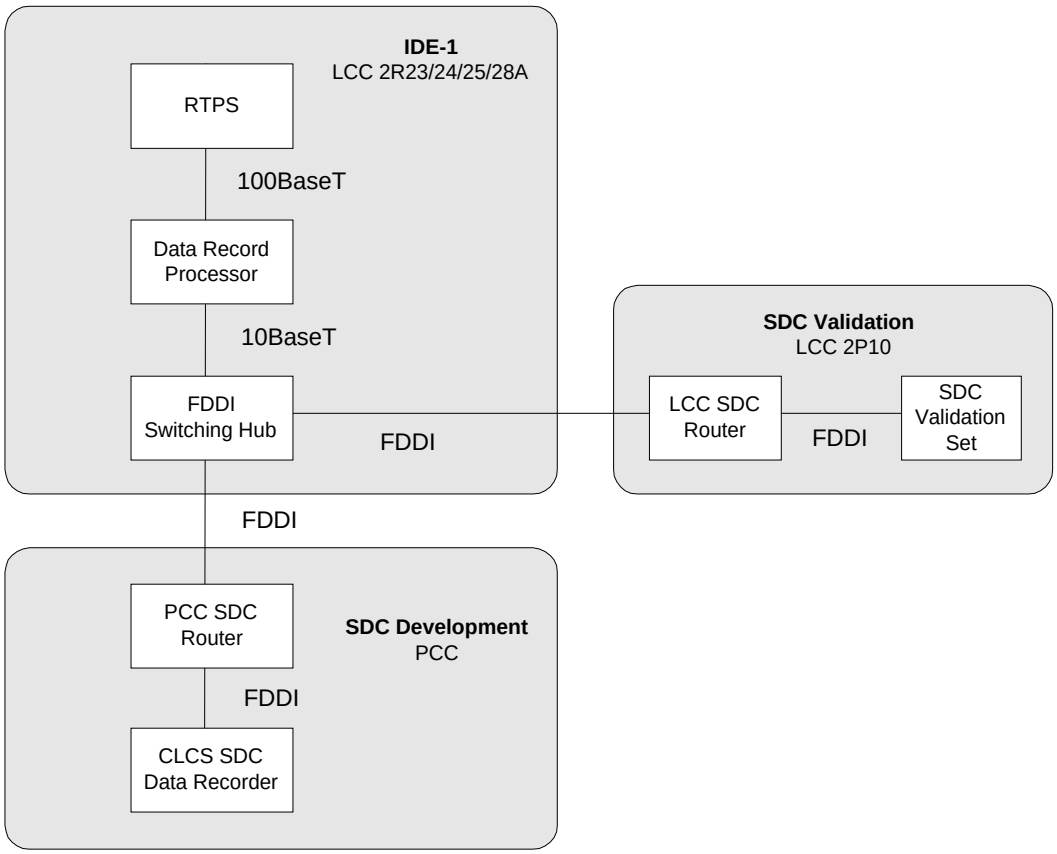
- 4.9.1 The system shall provide a method for logging function designators values and health indicators to a permanent archive. [Partial]
- 4.9.2 The system shall provide a method for logging text data to a permanent archive. [Partial]
- 4.9.3 The system shall provide a method for logging user defined data formats to a permanent archive. [Partial]
- 4.9.4The system shall provide a method for logging persistent FD information. [Partial]

- 4.9.5 The system shall provide a method for initializing, updating, and reading persistent storage structures. [None]

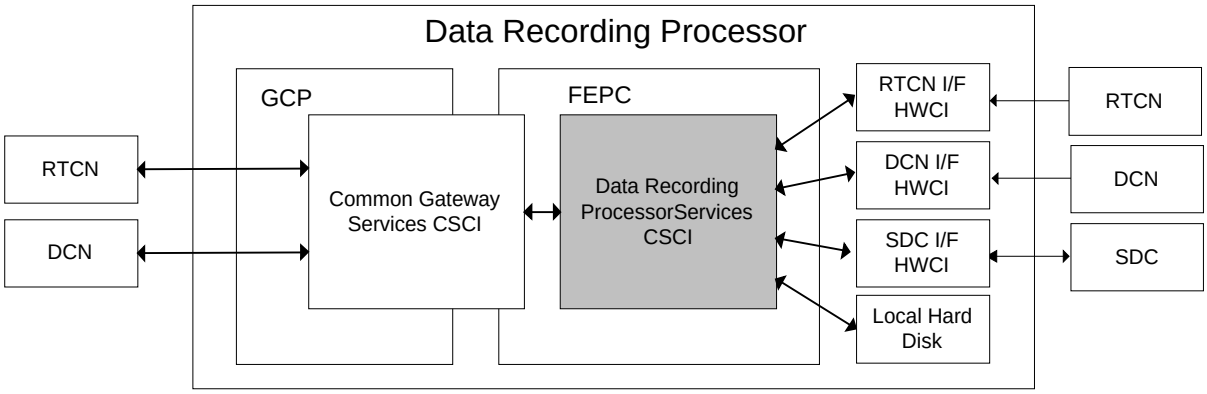
1.4

RECORD AND RETRIEVAL HARDWARE DIAGRAM

IDE-1 DRP to SDC Network Diagram



DRP Diagram



1.5 RECORD AND RETRIEVAL DELIVERABLES

Deliverable products for this capability (e.g., CSCI Object files):

Software:

Deliverable	R&D Document	Code	API Manual	Users Guide
Data Recording Processor Services	x	x	x	x
Record & Retrieve	x	x	x	

Hardware:

Deliverable	R&D Document	Drawings	Prototype	Users Guide
HWCI DRP	x	x	x	

DRP Quantities and availability are documented in section 3, HWCI Assessments.

Other:

None.

1.6 RECORD AND RETRIEVAL ASSESSMENT SUMMARY

1.6.1 Labor Assessments

The total Labor Costs required to provide this capability are summarized in the following table;

No.	CSCI/HWCI Name	Atlas LM	Changes covered in
1	Record & Retrieval CSCI - SDC Record CSC	12.0 LM	Record & Retrieval Thread
2	Record & Retrieval CSCI - SDC Retrieval CSC	6.0 LM	Record & Retrieval Thread
3	Record & Retrieval CSCI - SDC Data Server CSC	6.0 LM	Record & Retrieval Thread
4	DRP Services	10.0 LM	Record & Retrieval Thread
5	System Services	0 LM	System Services, System Messages
6	Common Gateway Services	0 LM	Common Gateway
7	Redundancy Management	0 LM	Redundancy Management
8	Reliable Messages	0 LM	Data Distribution & Routing
	TOTAL	34.0 LM	

1.6.2

Hardware Costs

The Hardware Costs required to provide this capability are summarized in the following table:

Item number	Name	Unit Cost	Qty.	Total	Assumptions
1	DRP (PowerPC)	20,000	16	$320,000	Prototype/New Buy
	Dual FDDI I/F		32	included in item1	Prototype/New Buy
	Dual 10/100Base I/F		32	included in item1	Prototype/New Buy
	IRIG Cards		16	included in item1	Prototype/New Buy
	24GB HDisk		16	included in item1	Prototype/New Buy
		Total:		$320,000	

1.6.3 Record and Retrieval Procurement

Performance requirements for the DRP have been extrapolated from the CCMS and current RTCN/DCN network data rates as substantiated earlier. The DRP configuration above should satisfy these requirements. However, other requirements which have not been resolved impinge on the DRP hardware configuration, such as network connectivity to SDC for remote sites. Therefore, rather than procuring the full complement of DRPs at the outset, two additional portable DRPs configured as above should be procured immediately (required for the labs). The adequacy of DRP configuration will be re-evaluated as performance and storage metrics are collected and requirements are delineated.

The trade study below compares the costs and performance characteristics of a UNIX based solution to that of a gateway-like PowerPC base solution. The PowerPC based configuration for the DRP has an almost 2 to 1 advantage.

Data Recording Processor Trade Study				
	Factor	**UNIX**	**Power PC**	
Cost	30%			
Purchase Cost	16 required	$960.00	$320.00	K$
Hardware Maintenance	5% for 5 Years	$240.00	$80.00	K$
	Total	$1,200.00	$400.00	K$
	Rating	**0.25**	**0.75**	
Software	30%			
Software Maintenance	Custom DDP Based	1		Effort
	Custom Gateway Based		0.9	Effort
Software Development	Custom DDP Based	1		Effort
	Custom Gateway Based		0.9	Effort
	Total	2	1.6	Effort
	Rating	**0.44**	**0.56**	
Expansion				
Cost	5%	$ 6,000.00	$ 3,000.00	
	Rating	**0.33**	**0.67**	
Number	5%	4	10	Number
	Rating	**0.40**	**0.60**	
Performance				
Time Tag	10%	1	0.001	MS
	Rating	**0.4**	**0.6**	
Throughput	10%	1.5	2.4	M bytes
	Rating	**0.38**	**0.62**	
	Total Rating	**0.32**	**0.58**	

The Data Recording Processor hardware and associated network connectivity hardware for two portable DRPs will be procured immediately.
A summary of the procurement schedule is shown below:

Procurement Activity	Completion Date
Define Prototype DRP Requirements	
Submit Purchase Request to Procurement	
Award Contract	
2 DRPs on dock	05/30/98

1.7

RECORD AND RETRIEVAL SCHEDULE & DEPENDENCIES

1.7.1 Schedule

Task Name	Start	Finish
Atlas Assessment Kickoff		
Concept Panel Internal Review	03/04/98	04/29/98
Concept Panel	03/06/98	05/07/98
Atlas Development (Atlas 1.0)		
Requirement Panel Internal Review	05/19/98	06/09/98
Requirement Panel	06/09/98	06/09/98
Design Panel Internal Review	06/19/98	06/19/98
Design Panel	06/19/98	06/19/98
CSCI Unit Testing	09/07/98	09/11/98
CSCI Development Integration Test	09/11/98	09/23/98
CSCI Formal Integration Test	09/23/98	09/30/98
Support System Integration Test	09/30/98	11/05/98
Atlas Development Complete	11/05/98	11/05/98

1.7.2 Dependencies

No.	Dependency Area	Dependency	Need Date
1	DRP	DRP Hardware	6/1/98
3	all	Data Providers must use RM	6/30/98
2	RM	Atlas RM	7/1/98

1.8 RECORD AND RETRIEVAL SIMULATION REQUIREMENTS

None.

1.9 RECORD AND RETRIEVAL INTEGRATION AND SYSTEM TEST

- Capture results of each of the tests below for use in subsequent regression testing and for comparative analysis.
- Availability of the Test Data Generator (TDG).
- When the TDG is utilized, it must be initialized in IRIG mode.

1. Data Test Using Stress Test Data
    1. Generate Data File for Test PC with Validation TCID
    2. Run Date Rate Ramping Test Data to TDG 1000 to 100,000 FD per second
    3. Test Data Generator Generating DDP Stream
    4. Record Test using Data Record Processor
    5. Confirm data in the operational recording File
    6. Perform List changes on selected FDs (100) from the Engineering Recording
    7. Run Date Rate Ramping Test Data to TDG 1000 to 100,000 FD per second
    8. Test Data Generator Generating 5 Gateway Streams
    9. Run DDP
    10. Record Test using Data Record Processor
    11. Confirm data in the operational recording File for Each Gateway Stream.

12. Confirm data in the operational recording File for DDP RTCN Output Stream.
13. Confirm data in the operational recording File for DDP DCN Output Stream.
14. Perform List changes on selected FDs (100) from the Engineering Recording.

2. Launch Playback Data Test
    1. Run Playback PC Program using launch data
    2. Test Data Generator Generating DDP Stream
    3. Collect Plot of selected FDs including TREF
    4. Record Test using Data Record Processor
    5. Confirm data in the Operational Recording File for TDG DDP stream.
    6. Perform List changes on the selected FDs (100) from the Engineering Recording
    7. Produce plot of the selected data
    8. Run Playback PC Program using launch data
    9. Test Data Generator Generating 5 Gateway Streams
    10. Run DDP
    11. Run CCPs
    12. Collect Plot of selected FDs including TREF
    13. Record Test using Data Record Processor
    14. Confirm data in the Operational Recording File for Each Gateway Stream
    15. Confirm data in the Operational Recording File for DDP RTCN Output Stream
    16. Confirm data in the Operational Recording File for DDP DCN Output Stream
    17. Perform List changes on the selected FDs (100) from the Engineering Recording
    18. Produce plot of the selected data

3. Simulation Data (using parts of gateway CITs)
    1. Run validation TCID Model
    2. Run Gateways
    3. Run DDP
    4. Run CCPs
    5. Run CCWS
    6. Command GSE function
    7. Command LDB function
    8. Record Test using Data Record Processor
    9. Confirm data in Operational Recording File
    10. Perform List changes on the selected FDs (5) from the Engineering Recording
    11. Perform List changes on Commands from the Engineering Recording
4. Other Message Types (using parts of other CITs)
    1. Other CITs run and record time of run
    2. After tests are performed retrieve selected test data from runs

1.10 RECORD AND RETRIEVAL TRAINING REQUIREMENTS

None.

1.11 RECORD AND RETRIEVAL FACILITIES REQUIREMENTS

TBD.

1.12 TRAVEL REQUIREMENTS

None.

1.13

RECORD AND RETRIEVAL ACTION ITEMS/RESOLUTION

ERP Issue #87 Recording Design is Protocol Dependent.
Partially satisfied. Wherever packet recording is done, a dependency will exist.

2. CSCI A

2.1 CSCI RECORD AND RETRIEVAL ASSESSMENT

CSC SDC Recorder Work Required

This is a list of work to be accomplished for this function.

- Socket Connection
- Receive Packet
- Packet Decode
- Create Recorder Instance
- Payload Packet Data Write
- Retrieval Optimized Recording
- Data Evaluator
- Recording Status Function (for Atlas, heartbeat only)

CSC SDC Retriever Work Required

This is a list of work to be accomplished for this function.

- Access FD
- Access Log
- Access C-T-C
- Access System Messages
- Access System Integrity

CSC SDC Data Server Work Required

This is a list of work to be accomplished for this function.

- Dispatcher Daemon
- Data source selection
- User notification
- AP File Builder
- AP File Accessor
- FD Request API
- Log Request API
- C-T-C Request API
- System Message Request API
- System Integrity Request API

Test Build and Load Thread Support

- OLDB Changes
  - New subtype for enumerated FDs
  - New string data type
  - User classes
  - Increase FD Name to 20 characters, FD Nom to 100 characters

System Control Thread Support

- provide the capability to record and retrieve resource assignment changes
- provide the capability to retrieve all resource assignments that were in effect at a given time or the latest

CSCI Assessment

CSC Name	CSC Labor (LM)	% of CSC
SDC Record	6.0	50
SDC Retrieve	6.0	40
SDC Data Server	6.0	50

Basis of estimate

The estimate of 24 Labor Months is based on two developers (12LM) working the recording CSC which includes interface to the DRP and two developers (12LM) working the retrieval engine and data server CSCs.

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	DP2s/ DP3s	50
Users Guide	N/A	10
API Interface Document	Retrieval APIs	25
Interface Design Document	DRP to SDC IDD	20
Test Procedure	Rcrd & Rtrvl CIT	10

Assumptions

none.

Open Issues

none.

2.2 CSCI DATA RECORDING PROCESSOR SERVICES ASSESSMENT

The DRP is the CLCS subsystem that collects data on the RTCN and DCN and forwards that data to the SDC for recording and retrieval. The DRP Services CSCI provides the functionality required to collect this data from the RTCN and DCN and forward it to the SDC and also store it to local storage media for transmission or retransmission during DRP to SDC communication losses. The DRP Services CSCI also transmits DRP/SDC combined subsystem Health & Status data to System Integrity.

DRP Services CSCI Work Required

- DRP Initialization & Termination
- DRP Command Processing
- Packet Payload Data collecting
- Packet Payload Data filtering
- Packet Payload Data forwarding
- Packet Payload Data local storage
- SDC to DRP health & status
- SDC to DRP retransmission/restart requests

- DRP to SSI health & status

DRP Services CSCI Assessment

CSCI Name	CSCI Labor (LM)	% of CSCI
DRP Services	10	

Basis of estimate

The estimate of 10 Labor Months is based on 6 and 4 Labor Months between two CLCS Gateway Subsystem developers. One developer (6 LM) will lead the DRP subsystem and develop all the code to interface with the Common Gateway Services CSCI. The other developer (4 LM) will develop all the code to collect, store locally, and forward data to the SDC.

Documentation

Document Type	New/Update	Number of Pages
Requirements and Design Documentation	DRP Services, DP-2 (new) DRP Services, DP-3 (new)	25 40
Users Guide	N/A	N/A
API Interface Document	N/A	N/A
Interface Design Document	RTPS Pky Pld ICD (update) DRP to SDC IDD (new)	2 20
Test Procedure	DRP Services CIT (new)	30

Assumptions

None.

Open Issues

None.

3. HWCI

Delivery of the production DRPs is needed by 09/04.
Delivery of the portable DRPs for development is needed by 06/30.

- Procure, configure and deliver 2 portable DRPs to Development areas.
- Procure, configure and deploy 4 production DRPs (HMF, IDE, SDE1, OCR1) to test sets.
- Provide network connection and enable data traffic from DCN to SDC for HMF, IDE, and SDE1.

4. COTS

None.

5.

CONCEPT OF OPERATIONS REFERENCE

SDC provides a centralized recording capability for time-tagged Shuttle processing data, RTPS configuration changes, error messages, system messages, inter-process communications, and other information. SDC provides the capability to record CLCS data and retrieve data that has been recorded. SDC also provides for the retrieval of existing CCMS data from either TDRR or PDR archives. In addition, SDC distributes RTPS data as a CLCS shuttle data stream. All data (both measurement and stimulus) to end items are recorded to SDC as processed engineering data with the capability to record raw counts as required. In addition, the SDC receives all system traffic effecting end items or system configurations. Network traffic is recorded to the SDC to aid in troubleshooting. In the event SDC is not available, local logging is provided with the ability to download local logging data to SDC. See Table 2-4.

	Data Link Recording Analog	Data Link Recording Digital	Packet Data Recording	Test Measurement and Message Data Recording
Launch Data Bus		Critical Operations	Gateway Output and Merged Stream	Merged Streams
Ground Data Bus		Trouble Shooting	Gateway Output and Merged Stream	Merged Streams
Orbiter FM	Critical Operations	Critical Operations	Select Data to RTPS	
Orbiter PCM	Critical Operations	Critical Operations	Gateway Output Merged Stream	Merged Streams
SSME PCM	Critical Operations	Critical Operations	Gateway Output Merged Stream	Merged Streams
Merged Data	Trouble Shooting	Trouble Shooting	Gateway Output Merged Stream	Merged Streams
RTPS Packets			All Operations	
RTPS Data			In Packets	Engineering Units all Operations Raw as required
Engineering Data			In Packets	Engineering Units all Operations Raw as required

Table 2-4. SDC Recording

Data link level recording provides the capability to record, retrieve, and playback PCM downlink and Orbiter FM signals. It also provides recording and retrieval for the LDB and ground data bus signals to aid in troubleshooting. CLCS provides selective access to this data in real-time from the RTPS and additional real-time viewing is provided in the SDC. Retrievals are provided as data files, tabular reports and plots. Additionally, data can be replayed for reprocessing by the RTPS.

Packet Data recording is used to record selective network traffic on the critical network within the CLCS system. Packet data is available on-line for up to 90 days for troubleshooting purposes, after which it will be archived. Retrieval application and products are similar to those provided by the PDR of CCMS.

Test measurement and message data recording is used to record all data related to the end items and its processing by CLCS. Data recording breaks apart the packets of data into the individual components (e.g., FD data, messages, etc.). The SDC then sorts, indexes and organizes this data for efficient retrieval. All data is available online for the greater of three flows of each vehicle or two years.

For test measurement and message data, SDC provides retrieval applications to report all aspects of the data including higher resolution time as well as heath and status information. For packet data these retrievals produce formatted dumps for selected time frames, filtered by types, data sources, and data destination. The data are available in the RTPS set and by way of a user-friendly interface to users at KSC and other NASA Centers.